Specifications for Hydrogen Retort/furnace System:

1. Inconel retort shall have gas inlet and outlet ports

2. retort shall be equipped with two thermocouple ports to accommodate furnace control and limit thermocouples

3. retort chamber dimensions will be approximately 7" x 7" x 7"

4. retort furnace shall be adequately insulated to prevent hot spots or scalding when coming into contact with the exterior shell during operation at maximum temperature

5. retort maximum use temperature to be at least 1050°C

6. furnace electrical requirements met by 208-VAC, 1-phase, 30-A service

7. furnace equipped with a programmable, multi-program controller capable of performing ramp, soak, dwell and cycling steps

8. furnace controller to be equipped with PC interface and include cable and software compatible with Windows XP Pro so that a user's PC can control furnace and record temperature histories; vendor may provide LabView VI's for furnace controller as an alternative to providing a specific software package

9. furnace to be equipped with a secondary over-temperature limit controller which removes power from the furnace heaters in the event of main controller failure resulting in loss of heater control and thermal run-away

10. furnace/retort package to include a ***hydrogen gas atmosphere control and safety system*** with the following features:

    a. routine start-up of the furnace/retort should include 10-times nitrogen purge of the retort volume with automatic switchover to hydrogen
    b. routine shutdown of the furnace/retort should include automatic switchover from hydrogen to nitrogen for 10-times purge of the retort
    c. exhaust port for retort should be plumbed to a hydrogen burn-off stack with gas igniter (e.g. silicon carbide)
    d. failure of the burn-off igniter will lead to furnace cooldown with switchover to nitrogen purging and triggering of audible and visual alarms
    e. loss of hydrogen pressure will trigger switchover to nitrogen purging, furnace cooldown, and triggering of audible and visual alarms
    f. loss of nitrogen pressure will trigger audible and visual alarms with furnace/retort remaining heated under the process gas
    g. power outage < 15 seconds will result in automatic reset of the furnace to prior run conditions
    h. power outage > 15 seconds should result in automatic switchover of gas flow to nitrogen to purge retort as furnace cools and require manual reset of furnace

i. if retort is equipped with water-cooled seals, gas control system should be interlocked to a water flow switch:
   1) loss of water flow < 30 minutes should trigger audible and visual alarms
   2) loss of water flow > 30 minutes should additionally trigger cooldown of furnace under nitrogen purge